Room Temperature Epitaxial Growth of Complex Oxide Interfaces with High Mobility Two-Dimensional Electron Gases

Chen, Yunzhong; Christensen, Dennis Valbjørn; Trier, Felix; Kasama, Takeshi; Yazdi, Sadegh; Linderoth, Søren; Pryds, Nini

Publication date:
2014

Room Temperature Epitaxial Growth of Complex Oxide Interfaces with High Mobility Two-Dimensional Electron Gases

Y. Z. Chen[1], D. V. Christensen[1], F. Trier[1], T. Kasama[2], S. Yazdi[2], S. Linderoth[1], and N. Pryds[1]

[1]*Department of Energy Conversion and Storage, Technical University of Denmark, 4000 Roskilde, Denmark*

[2]*Center for Electron Nanoscopy, Technical University of Denmark, 2800 Lyngby, Denmark*

Email: yunc@dtu.dk

❑ Creating high mobility oxide 2DEGs at room temperature

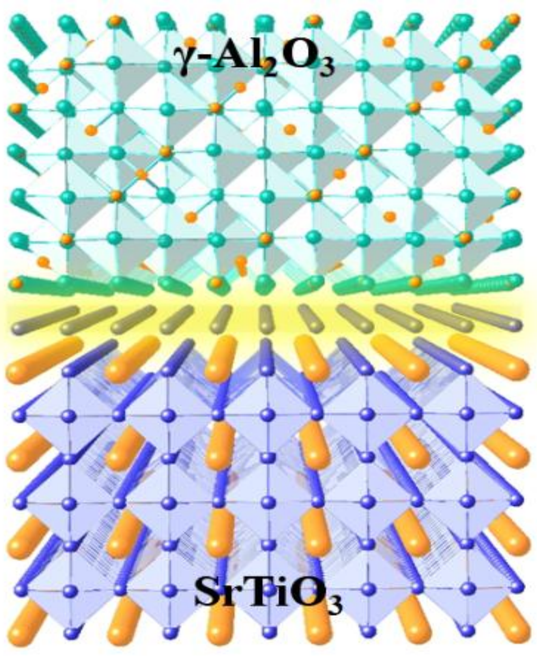
Motivation:

Two dimensional electron gases (2DEGs) formed at the interface between two insulating oxides provide new opportunities for electronics. However, it remains rather challenging to fabricate nano-patterened oxide 2DEGs without compromise in the high mobility. The room temperature created oxide 2DEG can make a difference since it can:

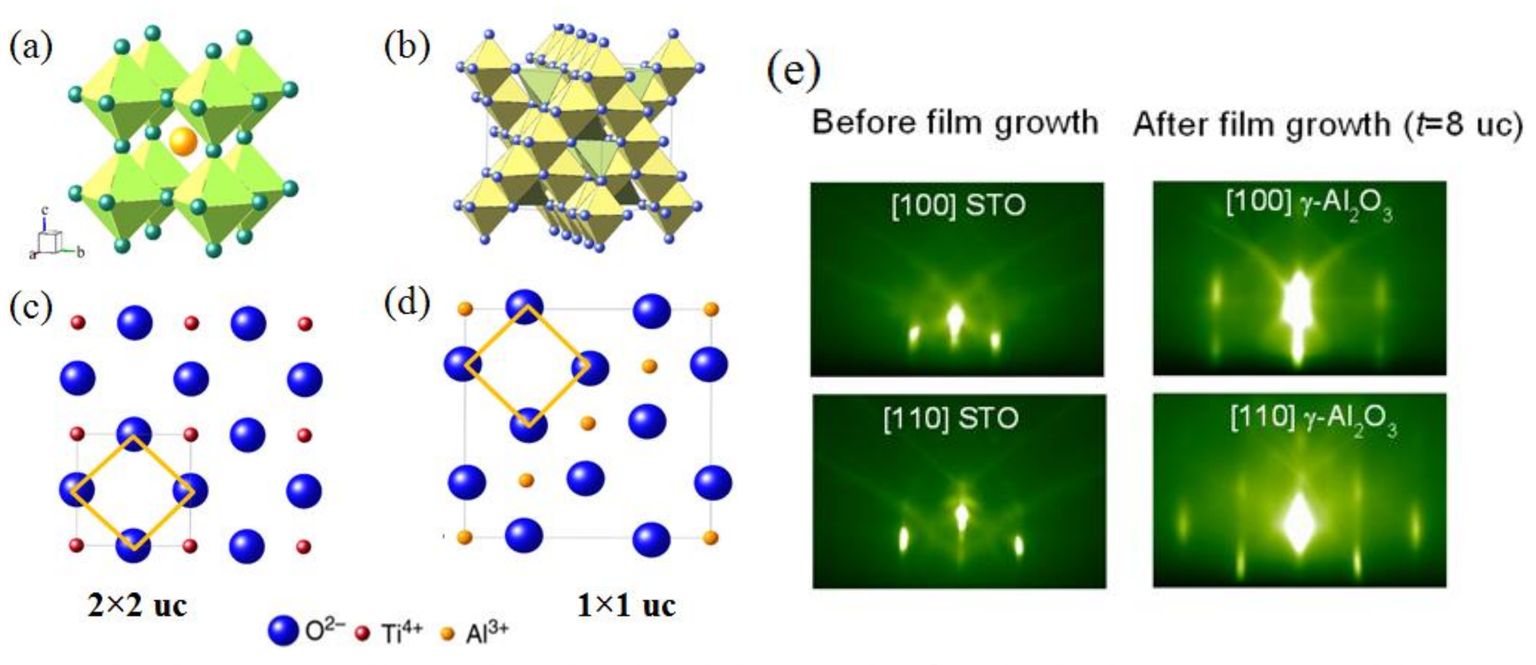
❖ **Suppress both the cation intermixing and the oxygen bulk diffusion across the interface;**

❖ **Compatible with the established lithography of semiconductor microfabrication for making patterned structures.**

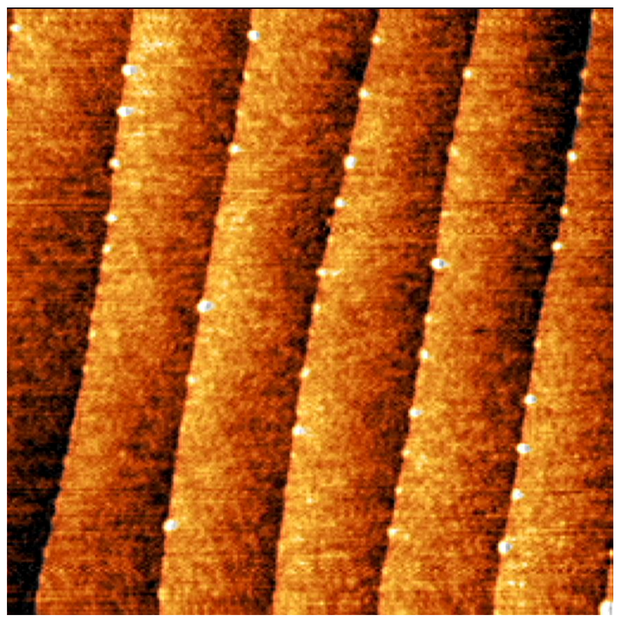
❑ Room temperature epitaxial growth of alumina on stronium titanate



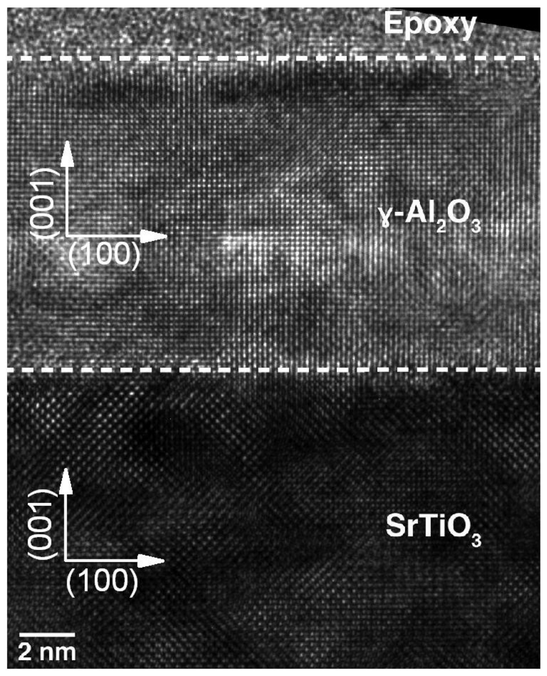
Sketch of the heterostructure



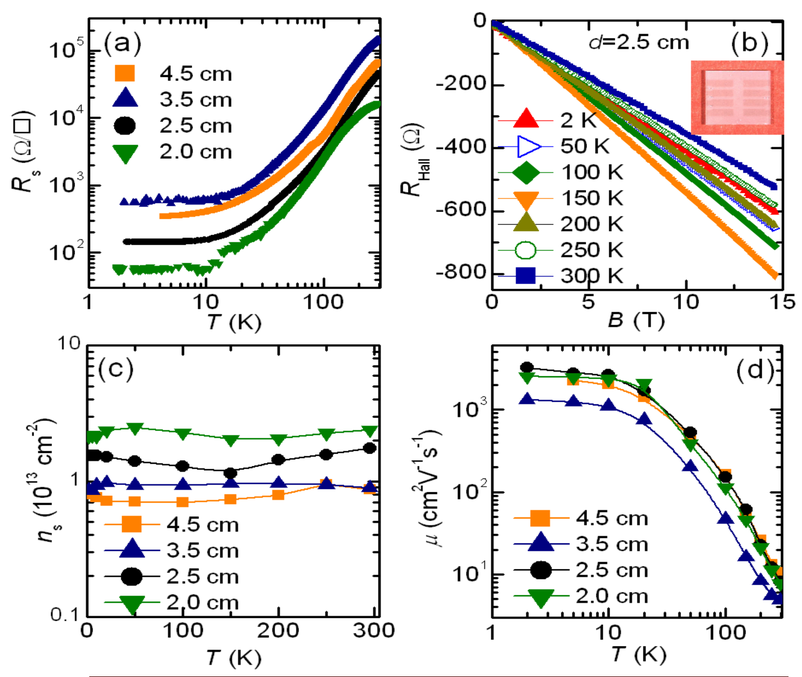
Layer-by-layer two dimensional epitaxial growth of spinel Al_2O_3 on perovskite $SrTiO_3$



Atomically smooth surface

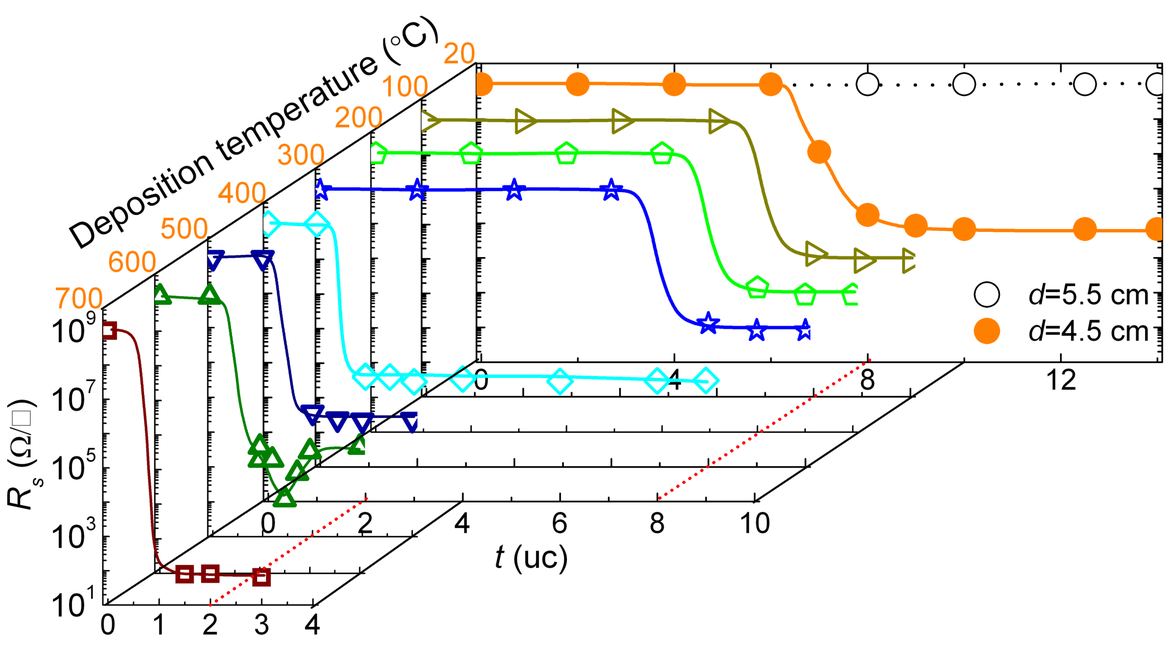


Sharp and coherent heterointerface

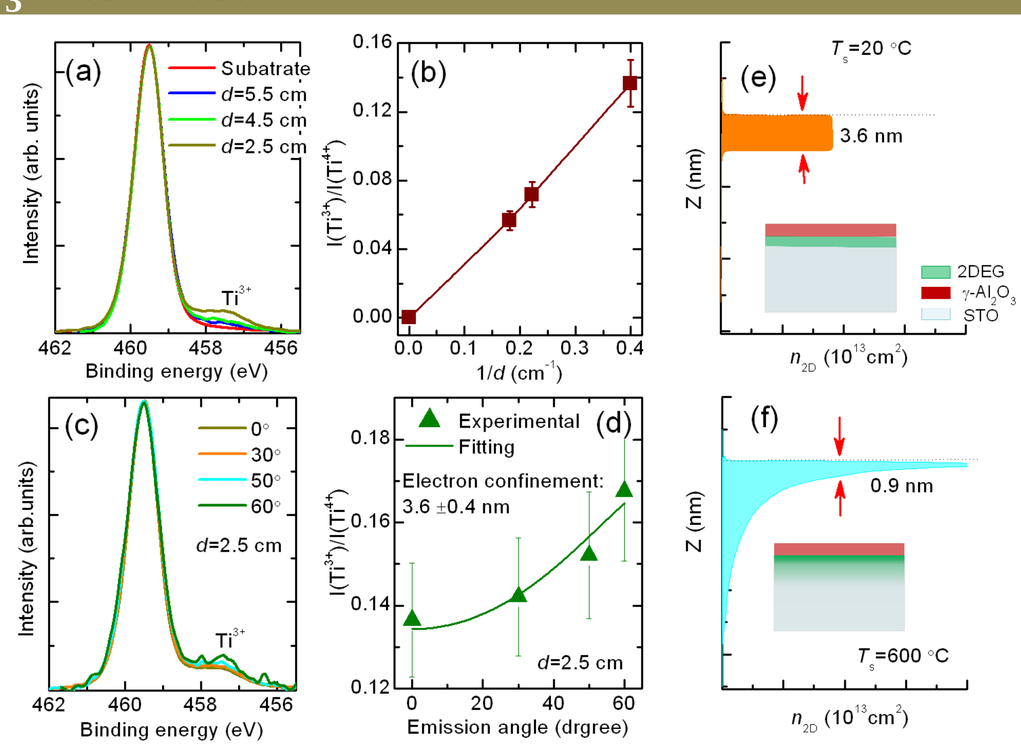


Metallic interface with high mobility

❑ Spatial confinement of 2DEGs at epitaxial $Al_2O_3/SrTiO_3$ interfaces



2DEGs formed at both high and low temperatures



Intrinsic spatial confinement of 2DEG at $Al_2O_3/SrTiO_3$ interfaces

❑ Reference

1) Y. Z. Chen *et al.* ***Adv. Mater.*** **26**, 1462 (2014); **2)** Y. Z. Chen *et al.*, ***Nat. Commun.*** **4:1371** doi: 10.1038/ncomms2394 (2013).